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MEMORANDUM

To: Project Selection Committee

From: CMAP Staff

Date: June 2014

Re: Documentation on methods used for proposed CMAQ scoring process

This spring, CMAP staff made an **initial proposal** for a new project ranking system to use in the Congestion Mitigation and Air Quality Improvement (CMAQ) program that is meant to enhance decision-making with project evaluation that integrates information on a wider range of benefits. In summary, the proposed approach ranks each project using a score from 0 to 100. Of the total, 30 percent of the score comes from "transportation impact criteria" that are specific to the type of project, while 10 percent is based on achieving certain regional priorities outlined in GO TO 2040. The lion's share of the score, 60 percent, is based on the cost-effectiveness of the air emissions reduction associated with the project. Please note that a high or low ranking does not necessarily imply a project will be selected for funding since other considerations, such as project readiness or sponsor capacity, influence actual project selection.

This memo provides documentation on the proposed scoring process for committee and stakeholder feedback. A spreadsheet is also available on the PSC website that shows how projects considered in the FY14-18 CMAQ cycle would have scored using the new procedure.

Transportation Impact Criteria

The currently proposed transportation impact criteria and their weights are as follows:

Project type	Criteria and Weights				
Highway	Reliability	Safety	On CMP network		
	15	10	5		
Transit	Ridership	Reliability (trans	it service) or asset		
		condition (tra	nnsit facilities)		
	15	1	.5		
Bicycle	Safety &	Transit	Facility		
	attractiveness	accessibility	connectivity		
	10	10	10		
Direct Emissions	Benefits sensitive	Annual health	Improves public		
Reduction	population	benefits	fleets		
	20	5	5		

Highway Projects

Travel time reliability score

This is composed of a quantitative and a qualitative evaluation. The quantitative portion is based on the planning time index (95th percentile travel time divided by free flow travel time) and takes a maximum of **10**. The Planning Time Index is calculated for the project footprint based on speed probe data for 2012 provided by the vendor Midwest Software Solutions (MS2) through an agreement with IDOT. (These data will be updated going forward and will likely be for 2012 and 2013 together in the FY16-20 program evaluation.) The score was calculated based on the percentile shown in the middle column in the table below. Points were assigned for each project as follows:

Maximum Approach	Percentile (weighted by distance)	Score
PTI*		
<= 1.40	0 - 50 th	2
1.41 to 1.81	51st to 75th	4
1.82 to 2.55	76 th to 90 th	6
2.56 to 3.35	91st to 95th	8
3.36 and greater	>95 th	10

^{*} Maximum corridor PTI for signal interconnects and for bottleneck eliminations; maximum intersection leg PTI for intersection improvements.

The qualitative dimension of the score has a maximum of **5** and is developed by determining whether the project has any of the following characteristics or helps implement any of the following as part of a larger program:

Systematic Improvements	Score	
Integrated Corridor Management		
Workzone management (traveler information improvements)		
Truck travel information systems	4	
Strategies to improve transit on-time performance	4	
Ramp metering	4	
Road weather management systems	2	
Special event management	3	
Traffic signal interconnect	4	
Adaptive signal control		
Spot improvements:		
Highway-rail grade separation with more than 10K AADT and more		
than 10K annual minutes of delay lasting > 10 minutes	5	
Implementation of effective crash reduction strategy (e.g., access		
management) as part of highway improvement		
Highway-rail grade separation in ICC top 20 delay list		
Highway-rail grade separation with more than 5K AADT and >5K	2	

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annual minutes of delays lasting > 10 minutes		
Other highway-rail grade separation	1	
Incident Detection:		
Traffic Management Center (TMC) to TMC Communications	4	
Computer-aided dispatch (911 call center) to (TMC) communications	4	
Extension or improvement of real-time traffic surveillance on regional		
expressways and tollways, including video and detectors	3	
Integration of real-time probe data into incident detection procedures	3	
Establishment of detector health program	3	
Incident Response:		
Expansion of response operations capabilities (e.g., minutemen)	5	
Dispatch improvements, including center-to-operator and supervisor-to-		
operator communications (including supervisor-bus communications)	4	
Response equipment (e.g., minuteman vehicles)	4	
Levi Jent Decrees		
Incident Recovery:		
Expediting coroner's/medical examiner's accident investigation process	5	
Dynamic message signs (DMS, multiple, including arterial DMS)	3	
Incident-responsive ramp meters		
Speed Management Systems		
On-scene communication, coordination, and cooperation		
Development and improvement of highway closure detour routes		

Safety

Although CMAQ is not a safety program, the project development process will wind up addressing safety deficiencies if they exist. Other things being equal, then, it is more important to fund a project where safety problems are more severe. At its March 2014 meeting, RTOC suggested using the IDOT 5% report locations to score safety. At the time, these data had not been made available, but since then CMAP has acquired them. Thus, the score is simply 10 if the project addresses a 5% location and 0 if it does not.

Congestion Management Process highway system.

The regional Congestion Management Process (CMP) has identified a set of roadways on which it is particularly critical to minimize congestion. The CMP highway network consists of the National Highway System and the **Strategic Regional Arterial** system. The score is **5** if the project is on the CMP and **0** if not.

Direct Emissions Reduction Projects

Improving the condition of public fleets

Given the funding challenges of public agencies and the condition of public fleets, as a matter of policy a project improving public sector vehicles should be a higher priority than one benefitting the private sector. The score is **5** if the project improves publicly owned fleets and **0** if it does not.

Annual health benefits

Annual health benefits are calculated by US EPA's Diesel Emissions Quantifier at the county level and divided by annualized project costs. No points are given for a benefit/cost ratio less than \$1.00. One point is given for a cost/benefit ratio of \$1.00 and one point for each \$0.50 above that, with a maximum of 5 points.

Benefits to sensitive populations

Impacts from fine particulate matter emissions may be more pronounced in children and older adults, who are especially susceptible to illnesses caused or exacerbated by exposure to fine particulate matter. Minority and poverty status likely influence susceptibility as well. The sensitive population index shows the relative proportions of persons in a census tract who are over 65, under 5, minority, and low-income. For each of these categories, a tract was given a value from 0-4 based on the quintiles of that category in the region (e.g., a tract in the second quintile for population over 65 would receive a value of 2, while one in the fifth quintile would receive a value of 4). For income, a value of 4 was given if the tract median income was below half of the regional median income (\$31,140) and 0 if above that level. The data are from the 2010 decennial census.

The index is shown in Figure 1. The breakpoints for the census tracts are shown in the table immediately below. Theoretically the maximum value this index could take is 16. However, the highest value actually observed in a census tract is 14.

Index value	0	1	2	3	4
Percent age over 65	0%	8%	12%	18%	26%
Percent age under 5	0%	4%	6%	7%	9%
Percent minority	0%	12%	23%	40%	66%
Income	4 if median tract income <\$31,140; otherwise 0				

To score a project, the sensitive population index is then multiplied by an estimate of the population benefiting from the project, the magnitude of the emissions reduction, and the time of exposure. For localized projects, the population within 0.5 miles of the project was used. For transit projects, the service population was used, as it was assumed that the service population would be the most affected by emissions reductions benefits, along with the population within 0.5 miles of the project. Service board customer demographics were compared to the breakpoints in the sensitive population index to derive an index for the transit agencies.

The final project score is assigned on a scale of 0 to **20**. Any project where sensitive population index × population benefitting × magnitude of emissions reduction per operating hour × time of exposure ÷ exposure buffer area is greater than 250 kg per square mile receives one point, with one point for each 250 beyond that, up to a maximum of 20. This planning-level approach provides a simple, reasonable assessment of the level of benefit of a project for sensitive populations in the region.

Legend Sensitive populations index 0 - 3 7 - 8 9 - 11 12 - 14 Draft MPO counties

Figure 1. Sensitive populations index (2010)

Bicycle Facilities

Safety and attractiveness rating

The Bicycle and Pedestrian Task Force has developed a "safety and attractiveness rating" that scores the improvement in conditions for walking and biking that result from building a facility. A guide for scoring is shown in the table below. A project score is calculated as (safety and attractiveness rating after project – rating before project) × weight. In this case the weight is 2 so

that the maximum score is **10**. For example, building a protected bike lane along an arterial street with no accommodation currently would take the safety/attractiveness rating from 1 to 5 and earn a score of $(5-1) \times 2 = 8$. Ratings and their narrative descriptions are in the table below:

Narrative description	Rating
Impassable barrier for walking and bicycling	
Arterial road with no bike/ped accommodation	1
Arterial road with some bike/ped accommodation, including marked shared	
lanes, and collector streets with no accommodation;	
Low-speed, local streets with no bike/ped accommodation	
Unprotected bike lane; local and collector streets with full accommodation	
Trail or arterial sidepath, cycletrack, protected bike lane, buffered bike lane	5

Connectivity

At its March 2014 meeting, the Bicycle and Pedestrian Task Force suggested that a measure of connectivity be included in the bikeway project evaluations, and that this measure include either street network connectivity or connectivity to the bikeway system itself. The measure is the greater of either (a) the project's street network connectivity rating, measured with the Pedestrian Environment Factor, or (b) the connectivity of bikeways resulting from the project. This includes all bikeways, not just Regional Greenways and Trails Plan projects. This maximum is then partially weighted by the CMAP land use diversity index, which helps emphasize locations likely to generate short trips between nearby land uses conducive to cycling, to arrive at a final score. The measure is designed to recognize project proposals with substantial connectivity benefits along the full spectrum of rural to urban locations. The score has a maximum value of 10. The following table shows the assignment of points related to improving bikeway connectivity:

Project's Bikeway Connectivity Characteristics	Value Assigned
Project fills a gap between existing bikeways	10
Project intersects an existing bikeway	6
Project extends an existing bikeway	3
Project is a new isolated bikeway segment.	0

The procedures for calculating the Pedestrian Environment Factor and the Index of Land Use Diversity in the Chicago Region are described in documents linked to the CMAP Performance Measurement web pages. Below are samples of how this measure plays out under various scenarios:

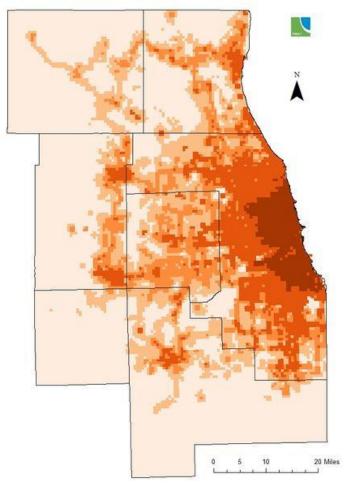
Column	A	В	С	D	E	F
Description	Bikeway	PEF	Greater of	Half of	Avg.	Score =
	Connect-		PEF or	Column	Land	D×(E
	ivity		Bikeway	C	Use	+1)
			Connectivity		Diversity	
Urban, Isolated Facility	0	9.67	9.67	4.84	0.58	7.64

Column	A	В	С	D	E	F
Urban, Connected Facility	6	7.41	7.41	3.70	0.61	5.99
Suburban or Rural, Isolated	0	2.25	2.25	1.12	0.44	1.62
Facility						
Suburban or Rural,	10	1.61	10	5	0.57	7.86
Connected Facility						

Transit accessibility index

Measuring transit accessibility helps ensure that a bicycle facility provides a realistic alternative to auto use by evaluating the potential to link bicycling with transit for longer trips. The measure was developed by CMAP for the GO TO 2040 update to provide a uniform measure of transit level of service available across the region during an average week (see map in Figure 2). The maximum score on this measure is 10. Since the transit accessibility index ranges from 1-5, the index is weighted by 2 to produce the score. Accessibility in all the subzones the project intersects is averaged to score the project. A full description of the calculation of the transit accessibility index will be posted in the GO TO 2040 Update Appendices.

Figure 2. Transit accessibility index (2010).



Color Code	Index Value	Subzone	Share of Regional Population	Share of Regional Employment	Transit Access Level
	1	8,850	7.3%	5.4%	Low
	2	3,242	20.1%	16.2%	Moderately Low
	3	1,874	16.3%	20.2%	Moderate
	4	1,851	29.7%	30.3%	Moderately High
	5	626	26.6%	28.0%	High

Transit Projects

Ridership increase

First-year ridership estimates from the FY10-14, FY12-16, and FY14-18 programs that were provided by applicants or calculated by staff were combined into one dataset. The quintiles were calculated and used to define the scoring system with a maximum score of **15**.

Ridership	Percentile	Score
<254	$0 - 20^{\text{th}}$	3
255 - 436	21 - 40 th	6
437 - 1,002	41 – 60 th	9
1,002 - 1,829	61 – 80 th	12
>1,830	>80th	15

Travel time reliability score

The travel time reliability score is composed of a quantitative measure of on-time performance (OTP) on the particular route with a qualitative evaluation of the project's impact on reliability. The travel time reliability criterion only applies to transit service and equipment. It takes a maximum of **15**, with 7.5 points coming from the quantitative measure. Only Pace has supplied system-wide on-time performance data so far. Staff anticipates asking for the route-level OTP on the CMAQ application form.

On-time performance	Score
< 60%	7.5
60% - 70%	6.0
70% - 80%	4.5
80% - 90%	3.0
>90%	0

The qualitative element of the score is based on the presence of the reliability-enhancing features in the table below. Projects can receive up to 7.5 points in this area. As with highway scoring, this qualitative method should be replaced as better technical tools for estimating changes to OTP are developed.

Rail	Score
New Vehicles	1.25
Upgraded Switches	1.25
Upgraded Power Supply	1.25
Positive Train Control	1.25
Station Consolidation	1.25
Track Improvements	2.50
Reduction of Freight/Vehicle/Pedestrian Interference	3.75
Bus	
New Vehicles	1.25
Queue Jump/Bypass Lanes	1.25
Off-board Fare Collection	1.25
Reduced Stops/Express Service	1.25
New Dispatching/Decision Support Systems	1.25
Passenger Vehicle Movement Restrictions	1.25
Transit signal priority	2.50
Multi-Door Boarding with Off-board Fare Collection	2.50
Bus-on-Shoulders	4.00
Managed Lanes	5.00
Dedicated Bus Way	7.50

For new service, an upgrade to conventional fixed route service will take a score based on the OTP of the local service on the route plus a qualitative score based on the reliability-enhancing features of the project. For example, a "basic" arterial rapid transit project along a route where the local service is 65% on-time would get a score of 6.0 based on OTP + 1.25 for reduced stops + 2.5 for transit signal priority = 9.75. New vehicle purchases for service anywhere in the system would receive a quantitative score based on the system average.

Existing asset condition

Other things being equal, it is more important to fund a transit facility or purchase new equipment where these assets are in worse condition. The Regional Transportation Authority's data will be used to define asset condition. Condition is rated based on a 1 – 5 scale, and project sponsors will be asked to provide that rating on the CMAQ application. This criterion would only apply to transit facilities. Entirely new facilities will receive a score of **0**. For the purpose of rescoring the FY14-18 program, asset condition was rated based on staff judgment since the RTA asset condition data were not available.

Narrative description	Rating
Excellent/Does not currently exist	0
Good	3.75
Adequate	7.50
Marginal	11.25
Poor	15

Other Projects

Some projects may not fit neatly into any of the categories above, and the CMAQ program at CMAP has an "Other Projects" submission form to accommodate these funding requests. For these projects, no transportation impact criteria would be used. Instead, the cost-effectiveness of emissions reduction would count for 90 points rather than 60. Project sponsors will be encouraged to discuss their proposals with CMAP staff before submission to ensure that they are best handled as "Other Projects."

Air Quality Cost-Effectiveness

Air quality cost-effectiveness is measured as either the cost per kilogram of volatile organic compounds (VOC) reduced or the cost per kilogram of fine particulate matter (PM2.5) reduced. In order to compare the opportunity costs of projects that have unequal lifespans, cost-effectiveness values were annualized according to the formula:

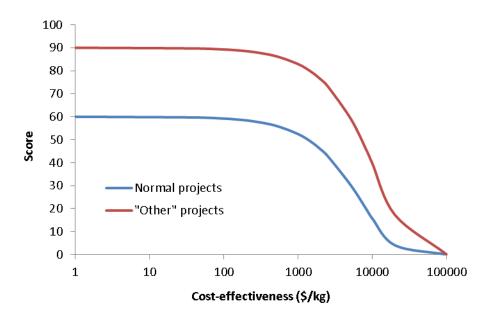
$$\text{Cost-effectiveness} = \frac{\text{Project } \cos t \times \frac{i}{1 - (1 + i)^{-n}}}{\text{Annual emissions reduction}}$$

The last term in the numerator is the capital recovery factor, where i = discount rate and n = the useful life of the project in years as reported by project sponsors. A discount rate of 3% was used, in line with typical U.S. Environmental Protection Agency practice.

After annualizing, cost-effectiveness was converted to a point value between 0 and 60 (except for projects classified as "other," for which the range was 0 to 90 points). Because projects submitted for funding under CMAQ show a very wide range in cost-effectiveness values, the distribution of project cost-effectiveness is skewed well to the right. In the FY14-18 program, the median cost-effectiveness was \$5,150 per kilogram VOC reduced while the average was \$43,500. Cost-effectiveness ranged from \$40 to over \$1 million per kilogram VOC eliminated. Projects in the upper part of this range cannot realistically be considered to have air quality benefits. Given this skew and the need to have better separation between projects in the lower part of the range, it would not be appropriate to rescale the cost-effectiveness range linearly. Instead, a simple non-linear approach to rescaling was used in which:

Project score = Maximum score
$$\times \exp(-k \times \text{cost-effectiveness})$$

The maximum score is 60 for most projects and 90 for "other" projects. The parameter *k* was set so that the middle score of 30 corresponds to the median cost-effectiveness in the FY 14-18 program. This scoring approach preserves variation in cost-effectiveness values while reflecting professional judgment about what constitutes a cost-effective project. It can be seen in the graph below that the score is most sensitive to changes in cost-effectiveness between about \$1,000 and \$10,000 /kg, which is in fact the range demarcating projects that perform reasonably well on cost and those that do not. Lastly, the same approach was used for direct emissions projects, only using the cost-effectiveness of PM2.5 removal.



Regional Priorities

Components of GO TO 2040 major capital projects

Projects that implement elements of GO TO 2040 major capital projects are given 10 points. In the FY 14 - 18 program, the following projects were eligible:

Intersection Improvement	II03143988	Elmhurst Rd and Touhy Av/IL 72	
Intersection Improvement	II08143971	ElginO'Hare Expy/Thorndale Av and Park	
		Blv Interchange, incl. Arlington Hts. Rd	
		Interchange	
Bottleneck Elimination	BE03143991	Touhy Av and UPRR	
Transit Service and Equipment	TI13143920	I90 Corridor Transit Access Improvement	
		Project	
Transit Facility Improvement	TI01143897	Union Station Transportation Center	
Intersection Improvement	II08143970	ElginO'Hare/Thorndale Av and I290	
		Interchange	
Intersection Improvement	II08143977	ElginO'Hare/Thorndale Av and IL 83	
		Interchange	
Intersection Improvement	II08143976	ElginO'Hare/Thorndale Av and Wood Dale	
		Rd Interchange	

Parking management, including parking pricing

Sponsors would submit this project via the "Other Projects" form. CMAQ projects that implement parking management strategies would be given **10** points. No projects were submitted in the FY 14-18 cycle that would fit this category.

Geographic targeting of funds

GO TO 2040 recommends establishing a geographically-targeted infrastructure funding source. CMAP is currently researching options for geographic targeting of infrastructure investment. This approach will not be ready in time for the upcoming FY 16-20 CMAQ cycle, and this category was not scored in the FY 14-18 reevaluation.

Transit-supportive land use

The viability of transit is closely connected to land use and neighborhood design, and so a major priority of GO TO 2040 is to encourage land use patterns that support transit. While the CMAQ program can fund a variety of transit improvements, not all potential work types have a particular nexus to land use. For example, transit vehicle improvements, signal priority systems, queue jumps, traveler information systems, and marketing initiatives are unlikely to have much impact on development, or vice versa. These are valuable enhancements that will increase ridership through improved speed and reliability of service, but have little bearing on land use.

Rather, the proposed scoring for transit-supportive land use is applicable to other GO TO 2040 priorities such as bus rapid transit (BRT) station improvements and rail station improvements; these work types hold the highest potential for supporting transit-oriented development. Major master-planned redevelopment projects conducted in tandem with transit improvements (past examples include Prairie Crossing in Grayslake and The Glen in Glenview) could also be considered regional priorities, although these projects should be evaluated on a case-by-case basis.

GO TO 2040 offers numerous recommendations to encourage local governments to better link transit, land use, and housing. As CMAP promotes the implementation of GO TO 2040, it is important to underscore the *adoption* of preferred policies. This scoring proposal is designed to reflect current zoning codes, serving as an incentive for local communities to implement transit-supportive land use policies and regulations. As such, it will require project sponsors to provide additional supporting information on adopted zoning codes in the project area.

The scoring system has three main components for transit-supportive land use, as identified in academic research:¹

- *Density* Denser development in the vicinity of a transit stop supports higher ridership.
- *Diversity* A mix of land allows transit to serve a larger variety of trip types across more periods of the day.
- Design Stations and surrounding development should be integrated to allow convenient access to transit.

In addition, much research has highlighted the importance of distance to the transit station on ridership.² The proposed scoring system looks at measures of density, design, and diversity

¹ Robert Cervero and Kara Kockelman, 1997. Travel demand and the 3Ds: Density, diversity, and design. *Transportation Research Part D* 2 (3), 199-219.

within one-half mile of transit, consistent with planning practices at the Regional Transportation Authority.

Scoring is as follows:

	Max	Criteria				
	Score					
Density	5	Up to 3 points will be awarded based on the permitted density for resi and non-residential land uses within one-half mile of the transit station more than one residential or non-residential classification is zoned wit station area, points will be assigned to the classification with the higher permitted density. Points will be assessed based on both residential <i>and</i> non-residential densities. If the two categories yield different point totals, the average two point totals will be awarded.				
		Permitted Densities:				
		Residential (DU/buildable acre)	Non-Residential (FAR)	Points		
		< 6	≤ 1.0	0		
		> 6 and ≤ 10	$> 1.0 \text{ and } \le 2.0$	0.5		
		> 10 and ≤ 16	$> 2.0 \text{ and } \le 3.0$	1.0		
		> 16 and ≤ 24	$> 3.0 \text{ and } \le 4.0$	2.0		
		> 24	>4.0	3.0		
		parking requirements, bace available for other				
		 uses (one point for each strategy implemented): Reduced minimum parking requirements Enacted maximum parking requirements Shared parking permitted In-lieu parking fees permitted Enacted bicycle parking requirements Off-street parking is required behind or underneath buildings Off-street parking is permitted off-site 				
Diversity	2.5	Up to 5 points will be awarded for the presence of mixed-use zoning within one-half mile of transit project (2.5 points for each strategy implemented):				
		esidential units above				

² Reid Ewing and Robert Cervero, 2010. Travel and the Built Environment: A Meta-Analysis. *Journal of the American Planning Association* 76 (3), 265-294.

		 Zoning allows pedestrian-friendly diverse land uses (e.g., drugstores, groceries, dry cleaning, banks, restaurants, gyms, hardware stores, libraries, etc.). Zoning excludes car-dependent land uses (e.g., drive-through stores, strip malls, etc.). 		
		Communities that have implemented form-based codes may require		
		additional qualitative analysis from CMAP staff to ensure their zoning meets		
		the above standards.		
Design	2.5	Up to 2.5 points will be awarded based on pedestrian-friendly designs		
		currently implemented within one-half mile of transit station (one point for		
		each strategy implemented):		
		 Continuous sidewalks on both sides of street Short block lengths/high intersection density Marked pedestrian crosswalks ADA accessibility features (curb ramps, truncated dome mats, accessible pedestrian signals, etc.) Enhanced pedestrian crossing strategies (in-road "Stop for Pedestrians" signs, pedestrian refuges, signals and timers, etc.) Traffic calming strategies (bump-outs, road diets, speed bumps, neighborhood traffic circles, chicanes, etc.) Lighting, street furniture, and streetscape beautification Zoning requires building facades to be located close to sidewalks 		

In the rescored FY 14-18 program, the following transit facility projects receive points under this criterion:

	Density				
Description	Permitted Densities	Parking	Diversity	Design	Total
Monroe Station Reconstruction CTA Red Line	3.5	1.5	2.5	2.5	10
State/Lake Reconstruction - CTA Loop Elevated	3.5	1.5	2.5	2.5	10
Union Station Transportation Center*	N/A	N/A	N/A	N/A	N/A
Washington/Wabash Station on Loop Elevated to					
replace Randolph/Wabah and Madison/Wabash	3.5	1.5	2.5	2.5	10
Maywood Train Station Facility	1.5	0.5	1.0	1.5	5
Randall Rd Transit Infrastructure Improvements	0.5	0	0	0.5	1
Regionwide Transit Access Improvements	1.0	0.5	0.5	1.0	3
Pedestrian Infrastructure Improvements: Pace Bus					
Routes 350, 352, 364, 572, 529, 381, 395, 877, 888**	N/A	N/A	N/A	N/A	N/A

^{*} Received priority as a component of a GO TO 2040 major capital project. ** Challenging to score because of multiple routes and jurisdictions; also unlikely to have major land use impacts.